Snake River - Hells Canyon

Total Maximum Daily Load (TMDL)

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Prepared by:

Idaho Department of Environmental Quality
Boise Regional Office
1445 North Orchard
Boise, Idaho 83706

Oregon Department of Environmental Quality
Pendleton Office
700 SE Emigrant, Suite 330
Pendleton, Oregon 97801

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We would like to acknowledge the efforts of local citizens, county governments, local industries, municipalities, soil and water conservation districts (SWCDs), watershed councils, irrigation districts and companies, tribal entities (including the Nez Perce, Shoshone-Paiute), local Watershed Advisory Groups, Idaho Power Company, the states of Oregon and Idaho including Oregon Department of Fish and Wildlife (ODFW), Oregon Water Resources Department (OWRD), Oregon Department of Agricultural (ODA), Idaho Department of Fish and Game (IDFG), Idaho Department of Health and Welfare (IDHW), Idaho Department of Agriculture (IDA), various environmental entities including Idaho Rivers United, the Hells Canyon Preservation Council, Trout Unlimited, Oregon Trout, Friends of Brownlee, and others, and Federal entities including the US Environmental Protection Agency (US EPA), US Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), US Bureau of Reclamation (USBR), US Forest Service (USFS), US Geological Survey (USGS), US Department of Agriculture (USDA), and numerous others.

The help we have received in collecting and evaluating data, and in developing and reviewing this TMDL has been invaluable! Local citizens, governments, municipalities and industries throughout the Snake River Basin have been instrumental in guiding the development of this TMDL.

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We would like to extend special thanks to the family of Dr. Lyle M. Stanford, especially his son Alan, for allowing us access to Dr. Stanford's books, notes, pictures and Ph.D. dissertation. Dr. Stanford's work provided us with a snapshot of the condition of the SR-HC TMDL reach between 1939 and 1942. His efforts were a resource for water quality data and assessments, and his photographs (many of which appear in this document) allowed us a virtual tour of the system

as it existed over 60 years ago. Dr. Stanford's work has been invaluable to this effort, and the efforts made to give us access are deeply appreciated.

Finally, we thank the citizens of Idaho, Oregon and surrounding states for their support of water quality in the Snake River and their expressed concern and participation in its restoration.

Snake River - Hells Canyon Total Maximum Daily Load (TMDL)

Abstract

The federal Clean Water Act requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters (33 USC § 1251.101). For waters identified as not meeting water quality standards and listed as impaired according to Section 303(d) of the Clean Water Act, states and tribes must develop a total maximum daily load (TMDL) for the pollutants causing impairment, set at a level to achieve water quality standards. The Snake River – Hells Canyon TMDL has been developed to comply with Idaho and Oregon's responsibilities within the Clean Water Act and state-specific TMDL schedules. This TMDL describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Snake River – Hells Canyon Subbasin located in southwestern Idaho and eastern Oregon. This TMDL consists of three major sections: 1) subbasin assessment, 2) loading analysis and allocation, and 3) water quality management or implementation plan(s).

The scope of the this TMDL extends from where the Snake River intersects the Oregon/Idaho border near Adrian, Oregon (Snake River mile (RM) 409) to immediately upstream of the inflow of the Salmon River (RM 188) (Hydrologic Unit Codes (HUCs) 17050115, 17050201 and 17060101, and a small corner of 17050103). This includes the Hells Canyon Complex reservoirs: Brownlee, Oxbow and Hells Canyon. The overall reach has been divided into smaller segments based on similar hydrology, pollutant delivery and processing mechanisms, and operational, management or implementation strategies. These include the following: the *Upstream Snake River* segment which extends from where the river intersects the Oregon/Idaho border near Adrian, Oregon (RM 409), downstream to Farewell Bend (RM 335). The *Brownlee Reservoir segment* includes Brownlee Reservoir from Farewell Bend (RM 335) to Brownlee Dam (RM 285). The *Oxbow Reservoir* segment includes Oxbow Reservoir from the outflow of Brownlee Reservoir below Brownlee Dam (RM 285) to Oxbow Dam (RM 272.5). The *Hells Canyon Reservoir* segment includes Hells Canyon Reservoir from the outflow of Oxbow Reservoir below Oxbow Dam (RM 272.5) to Hells Canyon Dam (RM 247). The *Downstream Snake River* segment includes the Snake River from below Hells Canyon Dam (RM 247) to immediately upstream of the Salmon River inflow (RM 188). Within these segments all designated beneficial uses and all listed pollutants from both states have been addressed by the TMDL with the exception of mercury. The following summary identifies the basic findings of the assessment and analysis process.

Bacteria. The Snake River is listed from RM 409 to 347 for bacteria. Analysis has shown that bacteria 303(d) listings are not indicated given the available data. Designated uses are not impaired due to elevated bacteria levels within any of the listed segments. Based on these findings, the TMDL recommends that the mainstem Snake River from RM 409 to 347 be delisted for bacteria by the State of Idaho.

Mercury. The Snake River is listed from RM 409 to 188 for mercury. The mercury TMDL for the Snake River- Hells Canyon reach has been postponed to 2006 in a US EPA approved action due to the fact that essentially no water column data are currently available to this effort.

Nutrients, Nuisance Algae and Dissolved Oxygen. The Snake River is listed from RM 409 to 272.5 for nutrients. Available data show excessive total phosphorus concentrations in the Upstream Snake River segment (RM 409 to 335) of the SR-HC reach. Nuisance algae blooms have been observed to occur routinely in the Upstream Snake River segment and the upstream sections of Brownlee Reservoir. Site-specific chlorophyll *a* and total phosphorus targets (less than 14 ug/L and less than or equal to 0.07 mg/L respectively) were identified by the TMDL. These targets are seasonal in nature and apply from May through September. Attainment of these targets is projected to result in a reduction of roughly 50 percent in algal biomass (as measured by chlorophyll *a*) that in turn will result in improvement in dissolved oxygen concentrations in both the Upstream Snake River and Brownlee Reservoir segments. The TMDL assigns waste load allocations to direct point source dischargers to the Snake River operating mechanical treatment plants to reduce discharge concentrations by 80 percent. Lagoon discharges will assess the feasibility of changing to land application or biological nutrient removal and implementation objectives will be assessed on a case by case basis. Nonpoint source discharges will be required to reduce to the 0.07 mg/L level. Inflowing tributaries have been assigned load allocations to meet the 0.07 mg/L total phosphorus target at their inflow to the Snake River. A load allocation for the addition of 1,125 tons of dissolved oxygen per season has been assigned to Idaho Power Company to offset reduction in assimilative capacity caused by the Hells Canyon Complex impoundments.

Pesticides. The Snake River is listed for pesticides from RM 285 to 272.5 (Oxbow Reservoir). Pesticides of concern are DDT and dieldrin, both of which are banned and no longer in use in the United States. TMDL targets were identified as less than 0.024 ng/L water column concentration DDT, less than 0.83 ng/L water column concentration DDD, less than 0.59 ng/L water column concentration DDE, and less than 0.07 ng/L water column concentration dieldrin. All available samples showed t-DDT fish tissue concentrations that exceeded the EPA screening level; no samples showed dieldrin fish tissue concentrations that exceeded the EPA screening level. All water column samples exhibited levels above the TMDL targets for both DDT and dieldrin. Load allocations for new application of these banned compounds are zero. Load allocations for legacy application and transport of DDT were established at less than 0.31 kg/year for RM 409 to 335 and less than 0.33 kg/year for Brownlee and Oxbow Reservoirs. Load allocations for legacy application and transport of dieldrin were established at less than 0.88 kg/year for RM 409 to 335 and less than 1.0 kg/year for Brownlee and Oxbow Reservoirs. These load allocations represent the sum of allowable point and nonpoint source-related loading. Pesticide targets apply year-round.

pH. The Snake River is listed for pH from RM 409 to 347 and from RM 335 to 285. Analysis has shown that pH 303(d) listings are not indicated given the available data. No exceedences were observed to occur from RM 409 to 335. Less than 1 percent exceedence was observed in the Brownlee Reservoir segment data. Based on these findings, the TMDL recommends that the mainstem Snake River from RM 409 to 347 and from RM 335 to 285 be delisted for pH by the State of Idaho.

Sediment. The Snake River is listed for sediment from RM 409 to 272.5. The TMDL has established targets of no more than 50 mg/L total suspended solids (TSS) as a monthly average and less than or equal to 80 mg/L TSS for no more than 14 days to protect aquatic life uses. Load allocations to meet the TMDL targets have been established for those tributaries and nonpoint sources (drains) that exceed target values at their inflow to the Snake River.

Temperature. The Snake River is listed from RM 409 to 188 for temperature. Elevated summer water temperatures have been measured in both the Upstream Snake River segment near Weiser, Idaho (RM 351), in the Hells Canyon Complex reservoirs, and in the Downstream Snake River segment prior to the construction of the dams. To address salmonid rearing temperature exceedences, point sources discharging directly to the Snake River within the SR-HC TMDL reach have been allocated heat loads corresponding to discharge loads applied to design flows to ensure that the no-measurable-increase requirements will be met. A waste load allocation for future point sources of no-measurable-increase has been identified as part of this TMDL. A gross nonpoint source temperature load allocation has been established at no greater than 0.14 ^{o}C for nonpoint sources in the SR-HC TMDL reach. A gross nonpoint source temperature load allocation has been established at no greater than 0.14 ^{o}C for tributaries in the SR-HC TMDL reach. These allocations apply at the inflow to the Snake River in the SR-HC TMDL reach, during those periods of time that the site-potential temperature in the mainstem Snake River is greater than 17.8 ^{o}C. A temporal shift in water temperatures exiting Hells Canyon Dam is observed during the late fall and winter months; the decline in temperature in the fall is delayed from that observed immediately upstream of the Hells Canyon Complex. While the temporal distribution of this temperature shift is due to the delay in flow caused by water moving through the Hells Canyon Complex, the actual heat load (warmer water) is not. The impoundments are not a heat source. Sources of elevated water temperature include natural, non-quantifiable and anthropogenic sources upstream of the Hells Canyon Complex and similar sources on inflowing tributaries. To address elevated temperatures occurring during salmonid spawning periods below Hells Canyon Dam, a temperature load allocation in the form of a required temperature change at Hells Canyon Dam was identified such that the temperature of water released from Hells Canyon Dam is less than or equal to the water temperature at RM 345, or the maximum weekly maximum temperature target of 13 °C for salmonid spawning, plus no greater than 0.14 ^{o}C.

Total Dissolved Gas. Total dissolved gas, while not a 303(d) listed pollutant, was addressed in the TMDL due to a direct request by members of the Public Advisory Team. Spill at Brownlee and Hells Canyon Dams is the source of elevated total dissolved gas within the lower SR-HC TMDL reach. A load allocation for total dissolved gas has been assigned to the Hells Canyon Complex that applies to each location where spill occurs (i.e. a load allocation of less than 110 percent of saturation applies to Oxbow Reservoir to address the effects of spill from Brownlee Dam, a load allocation of less than 110 percent of saturation applies to Hells Canyon Reservoir to address the effects of spill from Oxbow Dam, and a load allocation of less than 110 percent maximum saturation applies to the Downstream Snake River segment to address the effects of spill from Hells Canyon Dam).

It is recognized that the SR-HC TMDL addresses an extremely complex system that includes a combination of diverse natural, point, and nonpoint pollutant sources. The system has been highly modified from its original condition through the placement and operation of

impoundments; surface water diversions and drains; upstream and tributary modifications for hydropower production, irrigation storage, flood control and recreational use; and a variety of other anthropogenic activities. Data is available for some pollutants to determine whether the water quality standards are met, however, for other pollutants there is only limited data that does not conclusively show that the waters are impaired by such pollutants.

This TMDL has therefore adopted a phased approach to implementation that will identify interim, measurable milestones to determine the effectiveness of management measures or other action controls being implemented, and a process for reviewing and revising management approaches to assure effective management measures are implemented. Agencies responsible for the preparation and approval of the SR-HC TMDL (US EPA, ODEQ and IDEQ) recognize that long time-frames (potentially 50 to 70 years) may be required for water all quality standards to be consistently met.

The Implementation Plan submitted contains two separate, state-specific plans: the State of Oregon General Water Quality Management Plan and the State of Idaho General Implementation Plan. Together, these documents represent the general water quality management plan (implementation plan) for the SR-HC TMDL. In addition to the implementation plan submitted for the mainstem SR-HC TMDL reach, tributary plans will also be prepared as part of tributary TMDL processes. These plans will be prepared according to the appropriate state-specific schedules under which they are identified. It is also expected that information will continue to be collected to fill existing data gaps and allow a more accurate determination of the status of designated beneficial uses within the SR-HC TMDL reach and the influence of pollutants delivered to and processed by the system.

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Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters (33 USC § 1251.101). States and tribes, pursuant to section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants causing impairment, set at a level to achieve water quality standards. This document addresses the water bodies in the Snake River – Hells Canyon (SR-HC) Subbasin that have been placed on what is known as the "303(d) list."

This subbasin assessment and SR-HC TMDL analysis is a joint effort between the Idaho Department of Environmental Quality (IDEQ) and the Oregon Department of Environmental Quality (ODEQ), with participation by the US Environmental Protection Agency (US EPA) and local stakeholders.

What is a TMDL?

A TMDL is the amount of a particular pollutant that a specific stream, lake, river or other waterbody can tolerate without violating state water quality standards.

In this framework, a TMDL can be best described as a watershed or basin-wide budget for pollutant loading to a waterbody. A TMDL, in actuality, is a planning document. The "allowable budget" is first determined by scientific study of a stream to determine the amount of pollutants that can be assimilated without causing the stream to exceed the water quality standards set to protect the stream's designated beneficial uses (e.g., fishing, domestic water supply, etc.). This amount of pollutant loading is known as the *loading capacity*. It is established taking into account seasonal variations, natural and background loading, and a margin of safety. Once the loading capacity is determined, sources of the pollutants are considered. Both *point* and *nonpoint sources* must be included (US EPA, 1991b).

POINT SOURCES

Point sources of pollution are defined as discreet conveyances (e.g. pipes) that discharge directly into waterbodies, such as discharges associated with wastewater treatment plants. A point source is simply described as a discrete discharge of pollutants as through a pipe or similar conveyance.

NONPOINT SOURCES

Nonpoint sources, such as farms, lawns, or construction sites contribute pollution diffusely through run-off. Examples are sheet flow from pastures and runoff from forest logging. Nonpoint sources may include (but are not limited to), run-off (urban, agricultural, forestry, etc.), leaking underground storage tanks, unconfined aquifers, septic systems, farms, lawns, construction sites, stream channel alteration, and damage to a riparian area.

Once all the sources are accounted for, the pollutants are then allocated or budgeted among the sources in a manner that will describe the total maximum pollutant load that can be discharged into the river without causing the water quality standards to be exceeded. Ultimately the responsibility for improving water quality lies on the shoulders of everyone who lives, works or recreates in a watershed that drains into an impaired waterbody.

LOAD ALLOCATIONS

Load allocations are simply the amounts of pollutants that can be discharged from each source or category and still ensure that the total pollutant load does not exceed the loading capacity. The TMDL does not specify how the dischargers must attain their particular load allocation. The TMDL will not set best management practices for a discharger or otherwise tell the discharger how to meet their goal; it merely sets their goal.

Nonpoint sources are grouped into a "load allocation" (LA) and point sources are grouped into a "wasteload allocation" (WLA). By federal regulation, the total load capacity "budget" must also include a "*margin of safety*" (MOS). The "MOS" accounts for uncertainty in the loading calculation. The MOS may not be the same for different waterbodies due to differences in the availability and strength of data used in the calculations. The margin of safety cannot be "traded".
All together,

Loading Capacity = **TMDL** = **WLAs** + **LAs** + **Margin of Safety**.

The (point source) waste load allocation is implemented through an existing regulatory program under the federal Clean Water Act (CWA) called the National Pollutant Discharge Elimination System (NPDES) permit program. These permits set effluent quality limitations and require implementation of best available technologies that may include specific best management practices already established by the US EPA through regulation. Provided that a viable trading framework is in place, pollutant trading is allowed between, or within, the load allocation and the wasteload allocation categories.

In most cases, pollution load data already exists for most permitted point sources through the NPDES permitting process. Similar data are seldom available for nonpoint sources. Therefore, the TMDL process must develop similar load calculations for nonpoint sources of pollution, and for natural sources of pollution. In many circumstances, nonpoint source contributions will be broken down into additional categories, such as agriculture, development, forestry, or mining. Because it is difficult to identify specific nonpoint sources of pollution, it is unlikely that data will be collected on individual nonpoint sources (or landowners) along a waterbody. Instead, most TMDLs focus on estimating the cumulative or combined contribution of all nonpoint sources along a waterbody.

TMDLs generally consist of three major sections:

1) subbasin assessment,
2) loading analysis, and
3) water quality management or implementation plan(s).

SUBBASIN ASSESSMENT

A subbasin assessment describes the affected area, the water quality concerns and status of beneficial uses of individual water bodies, nature and location of pollution sources, and a summary of past and ongoing pollution control activities.

LOADING ANALYSIS

Loading analysis provides the estimate of a waterbody's pollutant load capacity, a margin of safety, and allocations of load to pollutant sources defined as the TMDL. Allocations are required for each permitted point sources and categories of non-point sources whose sum will meet the load capacity with load to spare as a margin of safety. Minor non-point sources may receive a lumped allocation. Generally a loading analysis is required for each pollutant of concern. But it is recognized that some listed pollutants are really water quality problems that are the result of other pollutants. For example, habitat affected by sediment or dissolved oxygen affected by nutrients causing nuisance aquatic growths. In these cases one listed stressor may be addressed by the loading reduction of another.

A complete loading analysis lays out a general pollution control strategy and an expected time frame in which water quality standards will be met. Long recovery periods (greater than five years) are expected for TMDLs dealing with non-point sediment or temperature sources. Interim water quality targets are recommended in these instances. Along with the load reductions, these targets set the sideboards in which specific actions are scheduled in the subsequent implementation plan.

WATER QUALITY MANAGEMENT OR IMPLEMENTATION PLAN

The implementation plan is guided by the TMDL and provides details of actions needed to achieve load allocations, a schedule of those actions, and follow up monitoring to document progress or provide other desired data. Implementation plans specify the local actions that lead to the goal of full support of designated beneficial uses. Important elements of these plans are:

- Implementation actions based on the load allocations identified in the TMDL
- An estimated time by which water quality standards are expected to be met, including interim goals or milestones as deemed appropriate
- A schedule specifying, what, where, and when actions to reduce loads are to take place
- Identification of who will be responsible for undertaking each planned action
- A plan specifying how accomplishments of actions will be tracked
- A monitoring plan to refine the TMDL and/or document attainment of water quality standards

To fulfil the requirements of the State of Oregon TMDL process, an implementation plan will be submitted to the US EPA with the SR-HC TMDL. IDEQ guidance states that a TMDL implementation plan should be developed within eighteen months of the approval of the TMDL it is intended to support and supplement. Because of this difference in procedure, a general implementation plan is being submitted with the SR-HC TMDL and other, more specific plans will be prepared and submitted according to the appropriate IDEQ or ODEQ schedule and

procedure. Together, these documents will represent the general water quality management plan (implementation plan) for the SR-HC TMDL.

Snake River - Hells Canyon TMDL General Information

This TMDL has been developed to comply with Idaho and Oregon's TMDL schedule. This assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the SR-HC Subbasin located in southwestern Idaho and eastern Oregon.

The first part of SR-HC TMDL, the subbasin assessment, is an important first step leading to the TMDL. The starting point for this assessment was Idaho's and Oregon's current 303(d) lists of water quality limited water bodies. Seven Idaho segments and four Oregon segments (corresponding to the same stretch of the Snake River) of the SR-HC Subbasin were identified on this list. The subbasin assessment portion of this document examines the current status of 303(d) listed waters, and defines the extent of impairment and causes of water quality limitation throughout the subbasin. The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards.

PUBLIC PARTICIPATION

Throughout the SR-HC TMDL process, local experience and participation have been and will continue to be invaluable in the identification of water-quality issues and reduction strategies appropriate on a local scale. During the initial stages of the SR-HC TMDL process, a structured public involvement program was established that included both local stakeholders and technical, agency personnel. This program was established so members of the local communities could provide direction and leadership in developing and implementing this plan. The public committee created is known as the SR-HC Public Advisory Team (PAT). The SR-HC PAT provides an opportunity for concerned citizens, representing a number of stakeholder groups, to see the SR-HC TMDL process through from start to finish.

Categories for stakeholder representation were identified by IDEQ and ODEQ according to state-specific protocols. Nominations for potential seatholders in each of these interest categories were solicited from the general public through letters to local governments, organizations, stakeholder groups, individuals, and watershed councils in both Oregon and Idaho. Generally, one representative from each state was selected from the nominations received to represent each area of interest. An alphabetical listing of the final stakeholder seats within the SR-HC PAT follows:

- Hydropower Interests
- Idaho Agricultural Interests
- Idaho Environmental Interests
- Idaho Local Government Interests
- Idaho Municipal Interests
- Idaho Public at Large
- Idaho Sporting/Recreational Interests
- Idaho Timber/Forestry Interests
- Industrial Interests
- Oregon Agricultural Interests
- Oregon Environmental Interests
- Oregon Local Government Interests

- Oregon Municipal Interests
- Oregon Public at Large
- Oregon Sporting/Recreational Interests
- Oregon Timber/Forestry Interests
- Other Idaho Interests
- Other Oregon Interests
- Tribal Interests – Nez Perce
- Tribal Interests – Shoshone/Paiute

The SR-HC PAT functions as an advisory body to the DEQs on SR-HC TMDL and implementation matters within the DEQ responsibilities outlined above. SR-HC PAT members help to identify contributing pollutant sources, advise the DEQs in arriving at equitable pollutant reduction allocations, and recommend specific actions needed to effectively control sources of pollution. Additionally, SR-HC PAT seatholders represent a critical mechanism in disseminating information to their respective interest groups, and relaying concerns and advice from these interest groups to the DEQs.

At the initial meetings of the SR-HC PAT, it was determined that due to the large geographical area of the SR-HC TMDL reach and the associated watershed, and the fact that the interests represented by separate SR-HC PAT seatholders may be divergent in their consideration of, and position on, some issues, the SR-HC PAT would not operate under a consensus-based process. The seatholders and the interagency team members (ODEQ and IDEQ) decided that there should be an opportunity for the submission (formally or informally) to the public record of opinions different from that of the SR-HC PAT in general, or to the approach, philosophy or methodology used by the DEQs in the formulation of the SR-HC TMDL.

In accordance with this decision, an informal record of differences in opinion on issues discussed is available to the public in the minutes from SR-HC PAT meetings, and in the listing of informal comments by SR-HC PAT members on initial drafts of the SR-HC Subbasin Assessment (and other sections of the SR-HC TMDL document as they become available) compiled by the DEQs. This information is available on request from the Cascade Satellite Office of IDEQ, PO Box 247, Cascade, ID 83611; and from the Pendleton Office of ODEQ, 700 SE Emigrant, Pendleton, OR 97801.

Subbasin at a Glance

The scope of the SR-HC TMDL extends from where the Snake River intersects the Oregon/Idaho border near Adrian, Oregon (Snake River mile (RM) 409) to immediately upstream of the inflow of the Salmon River (RM 188) (Hydrologic Unit Codes (HUCs) 17050115, 17050201 and 17060101, and a small corner of 17050103). This includes the Hells Canyon Complex reservoirs: Brownlee, Oxbow and Hells Canyon. Figure A shows the geographical scope of this TMDL.

Because of the extensive scope of this TMDL (RM 409 to 188), the overall SR-HC TMDL reach has been divided into smaller subsections or segments based on similar hydrology, pollutant delivery and processing mechanisms, and operational, management or implementation strategies.

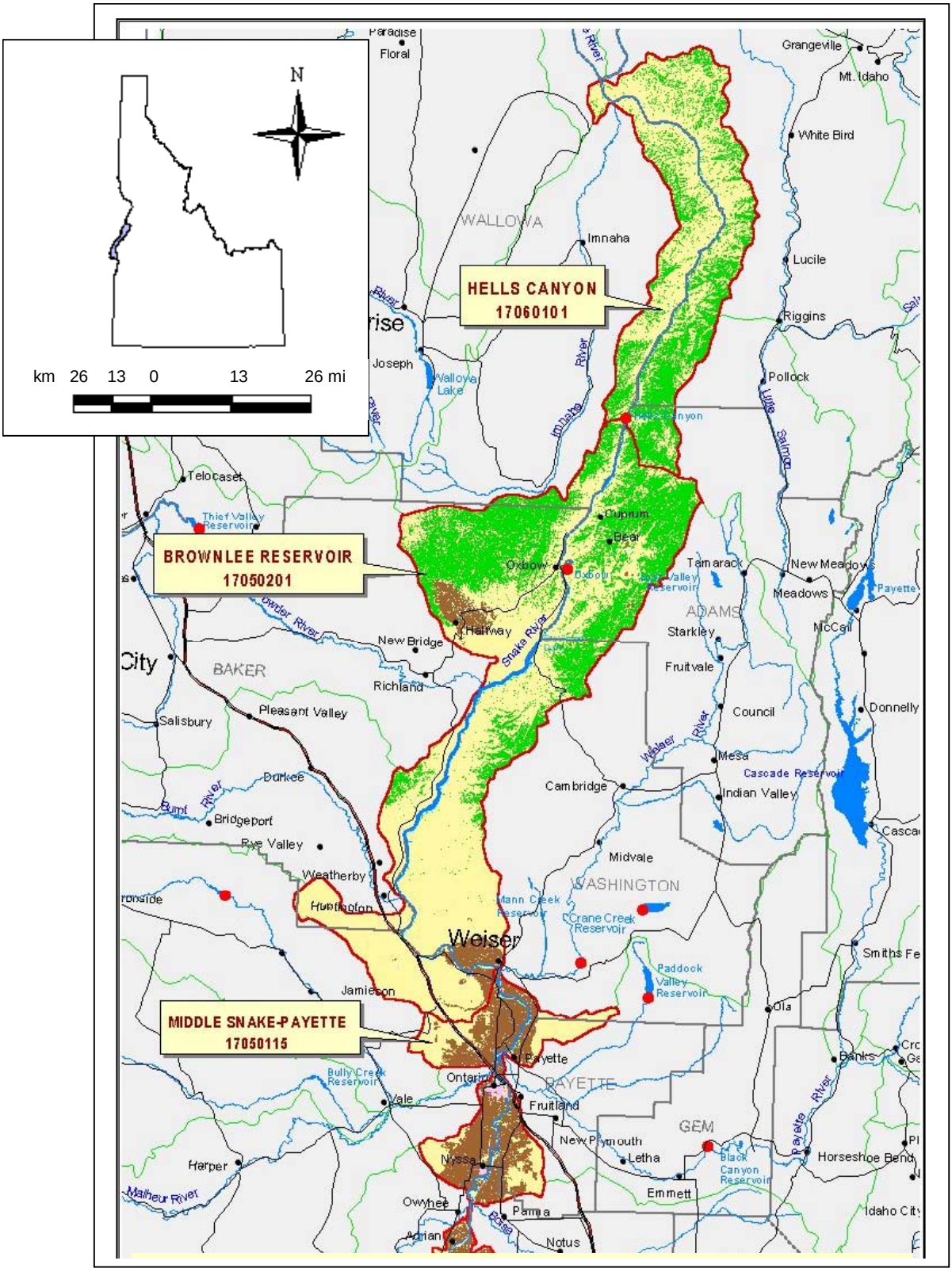

Figure A. Geographical scope of the Snake River – Hells Canyon TMDL

The five segments are:

- Upstream Snake River (RM 409 to 335, 74 miles total)
- Brownlee Reservoir (RM 335 to 285, 50 miles total)
- Oxbow Reservoir (RM 285 to 272.5, 12.5 miles total)
- Hells Canyon Reservoir (RM 272.5 to 247, 25.5 miles total)
- Downstream Snake River (RM 247 to 188, 59 miles total)

Figure B shows the separate segments as identified within the SR-HC TMDL reach.

The Upstream Snake River segment (RM 409 to 335) includes the riverine section of the Snake River upstream of the reservoir impoundments. It extends from where the river intersects the Oregon/Idaho border near Adrian, Oregon (RM 409), downstream to Farewell Bend (RM 335). All of the major tributary inflows to the SR-HC TMDL reach (with the exception of the Burnt and Powder rivers) enter the mainstem river within this segment. The vast majority of agricultural and urban/suburban land use occurs within the Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach. Flow within this segment is primarily driven by snowmelt and seasonal precipitation events, upstream and tributary impoundments, and irrigation diversions and returns. The 303(d) listed pollutants in this segment include bacteria, dissolved oxygen, mercury, nutrients, pH, sediment and temperature (1998 303(d) list).

The Brownlee Reservoir segment (RM 335 to 285) includes Brownlee Reservoir from Farewell Bend through the Brownlee Dam. While Brownlee Reservoir contains three fairly distinct hydrological regions: the riverine zone near the tailwaters (roughly RM 335 to 315), the transition zone (roughly RM 315 to 305), and the lacustrine zone (RM 305 to 285); water management and water quality concerns are well correlated with the reservoir boundaries. Total reservoir volume is 1,420,000 acre-feet. Flow into Brownlee Reservoir is made up of the outflow of the Upstream Snake River segment (RM 409 to 335), and the Burnt and Powder rivers that flow into Brownlee Reservoir at RM 327.5 and RM 296 respectively. However the inflow of these two tributaries is relatively minor when compared with the inflow from the Upstream Snake River segment, representing less than 2% of the combined total. Flow and residence time within the reservoir are controlled by the outflow through Brownlee Dam. Average residence time is 34 days, however, with consideration of the additional internal processes of stratification, depth of withdrawal, flood control requirements and management for power generation, the residence time in different parts of the reservoir can vary considerably. Listed pollutants in this segment include dissolved oxygen, mercury, nutrients, pH, sediment and temperature (1998 303(d) list).

The Oxbow Reservoir segment (RM 285 to 272.5) includes Oxbow Reservoir from the outflow of Brownlee Reservoir below Brownlee Dam to Oxbow Dam. The reservoir is much smaller than Brownlee Reservoir and has an average retention time of only 1.4 days. Flow into Oxbow Reservoir is almost exclusively the outflow of Brownlee Reservoir. Wildhorse River, which flows directly into the reservoir near the Brownlee Dam, constitutes less than 1% of the total inflow. Total reservoir volume is 57,500 acre-feet. Flow and residence time within the reservoir are controlled by the releases from Brownlee Dam and the releases from Oxbow Dam. Oxbow Reservoir is not operated for flood control. Due to its relatively small size, highly controlled inflow and outflow, and short residence time, water management and water quality concerns in

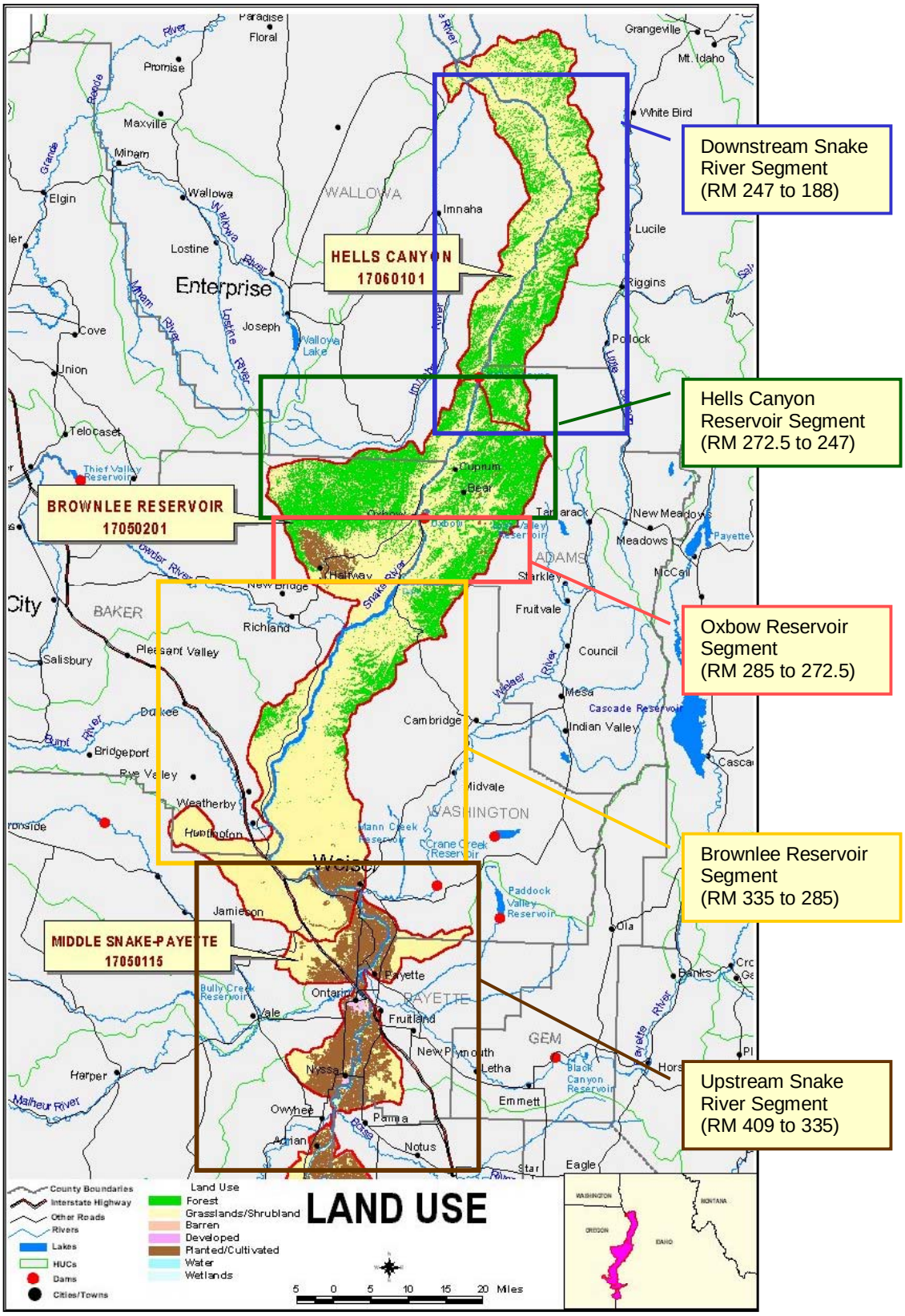

Figure B. Snake River – Hells Canyon TMDL segments.

this segment are well correlated with water quality upstream in Brownlee Reservoir. Listed pollutants in this segment include mercury, nutrients, pesticides, sediment and temperature.

The Hells Canyon Reservoir segment (RM 272.5 to 247) includes Hells Canyon Reservoir from the outflow of Oxbow Reservoir below Oxbow Dam to Hells Canyon Dam. This segment is also fairly small and fast flowing with a total volume of 170,000 acre-feet and has an average retention time of 4 days. Flow into Hells Canyon Reservoir is almost exclusively the outflow of Oxbow Dam. Pine Creek, which flows directly into the reservoir near the Oxbow Dam, constitutes less than 1% of the total inflow. The releases from Oxbow Reservoir and the releases from Hells Canyon Dam control flow and residence times within the reservoir. Hells Canyon Reservoir is not operated for flood control. Due to its relatively small size, highly controlled inflow and outflow, and short residence time, water management and water quality concerns in this segment are well correlated with water quality upstream in Brownlee and Oxbow Reservoirs. Listed pollutants in this segment include mercury and temperature (1998 303(d) list).

The Downstream Snake River segment (RM 247 to 188) includes the Snake River from below Hells Canyon Dam to immediately upstream of the Salmon River inflow. This segment is a rapid flowing, narrow river characterized by steep canyon walls and stretches of white water. The flow and volume of this segment are almost completely driven by the outflow of the Hells Canyon Complex reservoirs, and support substantial recreational uses year round. Listed pollutants in this segment include mercury and temperature (1998 303(d) list).

PARAMETERS (POLLUTANTS) OF CONCERN AND DESIGNATED BENEFICIAL USES

As this TMDL is a bi-state effort, the final document must meet the needs of both Oregon and Idaho. In order to accomplish this, all designated uses and listed pollutants from both states must be addressed by the TMDL. Therefore, the SR-HC TMDL addresses all listed pollutants from both Idaho's 303(d) list and Oregon's 303(d) list. These designated beneficial uses and the parameters of concern are listed in Tables A-1 and A-2.

KEY INDICATORS OF IMPAIRMENT

Designated beneficial use impairment and target exceedences have been identified to the extent possible given the available data set. Table B lists the pollutants from the 303(d) lists of Idaho and Oregon and the key indicators of impairment associated with each pollutant. Both quantitative (measured data) and qualitative (observations of system characteristics) methods were used in the evaluation of designated use support. Information on the occurrence of impairment indicators is included in Table B on a segment-specific basis. The information listed in Table B represents the current level of understanding of beneficial use impairment and system dynamics within the SR-HC TMDL reach. The phased implementation approach and iterative nature of the TMDL process will allow further refinement of the identified designated use impairment as additional data are collected and understanding of the system dynamics improves.

POLLUTANT SOURCES

Many, varied sources of pollutant loading have been identified within the SR-HC Subbasin. In some cases sources can contribute directly to exceedences of water quality targets (as in the case of excessive nutrient loading causing nuisance algae blooms. In other cases, pollutant sources

Table A-1. Idaho segment specific listing information for the Snake River - Hells Canyon TMDL reach.

Segment	Idaho 303(d) Listed Pollutants	Idaho Designated Beneficial Uses
Snake River: RM 409 to 396.4 Upstream Snake River (OR/ID border to Boise River Inflow)	(downstream from ID border) bacteria, dissolved oxygen, nutrients, pH, sediment	(downstream from ID border) cold water aquatic life primary contact recreation domestic water supply
Snake River: RM 396.4 to 351.6 Upstream Snake River (Boise River Inflow to Weiser River Inflow)	bacteria, nutrients, pH, sediment	cold water aquatic life primary contact recreation domestic water supply
Snake River: RM 351.6 to 347 Upstream Snake River (Weiser River Inflow to Scott Creek Inflow)	bacteria, nutrients, pH, sediment	cold water aquatic life primary contact recreation domestic water supply
Snake River: RM 347 to 285 Brownlee Reservoir (Scott Creek to Brownlee Dam)	dissolved oxygen, mercury, nutrients, pH, sediment	cold water aquatic life primary contact recreation domestic water supply special resource water
Snake River: RM 285 to 272.5 Oxbow Reservoir	nutrients, sediment, pesticides	cold water aquatic life primary contact recreation domestic water supply special resource water
Snake River: RM 272.5 to 247 Hells Canyon Reservoir	not listed	cold water aquatic life primary contact recreation domestic water supply special resource water
Snake River: RM 247 to 188 Downstream Snake River (Hells Canyon Dam to Salmon River Inflow)	temperature	cold water aquatic life salmonid spawning primary contact recreation domestic water supply special resource water

Table A-2. Oregon segment specific listing information for the Snake River - Hells Canyon TMDL reach.

Segment	Oregon 303(d) Listed Pollutants	Oregon Designated Beneficial Uses
Snake River: RM 409 to 395 Upstream Snake River (Owyhee Basin)	mercury, temperature	Public/private domestic water supply industrial water supply irrigation water, livestock watering salmonid rearing and spawning* (trout) resident fish (warm water) and aquatic life water contact recreation wildlife and hunting fishing, boating, aesthetics

Segment	Oregon 303(d) Listed Pollutants	Oregon Designated Beneficial Uses
Snake River: RM 395 to 335 Upstream Snake River to Farewell Bend (Malheur Basin)	mercury, temperature	Public/private domestic water supply industrial water supply irrigation water, livestock watering salmonid rearing and spawning* (trout) resident fish (warm water) and aquatic life water contact recreation wildlife and hunting fishing, boating, aesthetics
Snake River: RM 335 to 260 Brownlee Reservoir Oxbow Reservoir Upper half of Hells Canyon Reservoir (Powder Basin)	mercury, temperature	public/private domestic water supply industrial water supply irrigation water, livestock watering salmonid rearing and spawning* resident fish and aquatic life water contact recreation wildlife and hunting fishing, boating, aesthetics hydropower
Snake River: RM 260 to 188 Lower half of Hells Canyon Reservoir Downstream Snake River (Grande Ronde Basin)	mercury, temperature	public/private domestic water supply industrial water supply irrigation water, livestock watering salmonid rearing and spawning (downstream) resident fish and aquatic life water contact recreation wildlife and hunting fishing, boating, aesthetics anadromous fish passage commercial navigation and transport

Table B. Key indicators of impairment specific to listed pollutants for the Snake River - Hells Canyon TMDL.

Parameter	Indication of Impairment
Bacteria	Site-specific data showing concentrations greater than 126 *E coli* organisms per 100 mL as a 30 day log mean with a minimum of 5 samples OR samples greater than 406 *E coli* organisms per 100 mL. In the absence of site-specific data, key indicators of bacteria problems include illness in primary contact recreation users. • No segments of the SR-HC TMDL reach were found to exhibit these conditions.
Dissolved Oxygen (DO)	Site-specific data showing concentrations less than 6.5 mg/L water column where cool water aquatic life/salmonid rearing is the designated use for the State of Oregon or cold water aquatic life is the designated use for the State of Idaho. Less than 8 mg/L water column DO where cold water aquatic life is the designated use for the State of Oregon, less than 11 mg/L water column DO or intergravel DO lower than 8 mg/L when and where salmonid spawning is a designated use for either state. In the absence of site-specific dissolved oxygen data, key indicators of dissolved oxygen problems include fish kills, anaerobic sediments and lack of support for aquatic life uses. • The portions of the Snake River upstream of RM 409 were shown to exhibit dissolved oxygen concentrations below those required to support salmonid spawning and incubation. Water quality and substrate conditions in the

Parameter	Indication of Impairment
	Upstream Snake River segment (RM 409 to 335) parallel conditions upstream where dissolved oxygen violations were observed. • The Brownlee Reservoir segment (RM 335 to 285) was shown to exhibit dissolved oxygen target exceedences.
Mercury (Hg)	Site-specific data showing concentrations greater than 0.012 ug/L water column concentration total mercury and/or greater than 0.35 mg/kg methylmercury in fish tissue, and fish tissue advisories based on consumption concerns. • Fish in the Upstream Snake River segment (RM 409 to 335) were shown to exhibit exceedences of the fish tissue targets • Fish in the Brownlee Reservoir segment (RM 335 to 285) were shown to exhibit exceedences of the fish tissue targets
Nutrients Nuisance Algae	Key indicators of nutrient problems include excessive algae growth and associated dissolved oxygen and pH problems. For the State of Oregon, exceedence of 15 ug/L chlorophyll *a* (a surrogate for algae mass) indicates that there is potentially a problem with excessive nutrient loading. Chlorophyll *a* concentrations greater than 15 ug/L trigger an evaluation to determine the level of impairment. This TMDL represents that evaluation for the SR-HC TMDL reach. • Excessive algae blooms are observed to occur in the Upstream Snake River segment (RM 409 to 335) (see dissolved oxygen) • Excessive algae blooms are observed to occur in the upstream sections of Brownlee Reservoir (see dissolved oxygen)
Pesticides	Site-specific data showing water column concentrations of greater than 0.024 ng/L DDT, 0.83 ng/L DDD, 0.59 ng/L DDE, and/or 0.07 ng/L Dieldrin. • Fish in the Upstream Snake River segment (RM 409 to 335) were shown to exhibit exceedences of the fish tissue action levels. A very small data set shows water column target exceedences. Sediment concentrations are at levels of concern. • Fish in the Brownlee Reservoir segment (RM 335 to 285) were shown to exhibit exceedences of the fish tissue targets. Sediment concentrations are at levels of concern.
pH	Site-specific data showing pH measurements less than 7 and/or greater than 9 pH units In the absence of site-specific pH data, key indicators of pH problems include fish kills and lack of support for aquatic life uses. • No segments of the SR-HC TMDL reach were found to exhibit these conditions.
Sediment (Total Suspended Solids (TSS))	Site-specific data showing concentrations greater than 80 mg TSS/L for acute events lasting more than 14 days, and/or greater than 50 mg TSS/L monthly average In the absence of site-specific data, key indicators of sediment problems include lack or degradation of spawning habitat, population decline, feeding problems, gill and scale problems and reduced growth rates. • Duration data are not available to make a direct assessment of target exceedence. Habitat concerns exist in the Upstream Snake River and upstream Brownlee Reservoir segments. • The primary concern associated with sediment in this TMDL is as a transport mechanism for mercury, pesticides and nutrients. Sediment acts as an indicator of transport and delivery potential within the system.
Temperature	Cold water Aquatic Life/Salmonid Rearing: Site-specific data showing water temperatures with greater than a 0.14 ^{o}C increase

Parameter	Indication of Impairment
	from anthropogenic sources when the site potential is greater than 17.8 ^{o}C Salmonid Spawning: A maximum weekly maximum temperature of 13 ^{o}C (when and where salmonid spawning occurs) if and when the site potential is less than a maximum weekly maximum temperature of 13 ^{o}C. If and when the site potential is greater than a maximum weekly maximum temperature of 13 ^{o}C, the target is no more than a 0.14 ^{o}C increase from anthropogenic sources. Applicable to RM 247 to 188 only, from October 23rd to April 15th for fall chinook, and from November 1st to March 30th for mountain whitefish. Or site-specific data showing water temperatures with greater than a 0.14 ^{o}C increase from anthropogenic sources when aquatic species listed under the Endangered Species Act are present and a temperature increase would impair the biological integrity of the Threatened and Endangered population. In the absence of site-specific data, key indicators of temperature problems include fish kills, lack or loss of habitat, unsuccessful spawning and reduced growth rates. • Exceedences of the temperature target for cold water aquatic life and salmonid rearing occur to some degree during June, July, August and September throughout the SR-HC TMDL reach. • These exceedences were determined to be primarily due to natural and non-quantifiable conditions. Exceedences were observed historically in the Upstream Snake River segment (RM 409 to 335) and in the reservoir segments before the impoundments were in place. • Exceedences of the temperature target for salmonid spawning occur to some degree during mid-October in the Downstream Snake River segment (RM 247 to 188).
Total Dissolved Gas (TDG)	Site-specific data showing concentrations greater than 110% total dissolved gas saturation In the absence of site-specific data, key indicators of total dissolved gas problems include gas bubble disease in fish. • Exceedences of the total dissolved gas target are observed to occur in Oxbow, Hells Canyon reservoirs and in the Downstream Snake River segment during periods of spill.

can contribute indirectly to water quality target exceedences (as in the case of sediment transporting mercury within the subbasin, or algae growth leading to dissolved oxygen sags). To the extent possible, pollutant sources have been identified within the SR-HC Subbasin, however, some sources may not have been identified and, with the collection of additional data, some sources currently identified may be found to contribute less of a load than assessed. The sources listed in Table C represent the current level of understanding of pollutant loading, transport and delivery to the SR-HC TMDL reach. The phased implementation approach and iterative nature of the TMDL process will allow further refinement of the identified sources as our understanding of the system improves.

Key Findings

The SR-HC TMDL reach is a very complex system exhibiting varying hydrology, pollutant processing and transport characteristics, and anthropogenic influences. In many cases the data

Table C. Pollutant sources within the Snake River - Hells Canyon TMDL reach.

Parameter	Pollutant Source
Bacteria	No segments of the SR-HC TMDL reach were found to exceed the targets. While there may be sources of bacteria in the subbasin, they are not currently observed to be contributing to designated use impairment in the SR-HC TMDL reach.
Dissolved Oxygen (DO)	• Point sources discharging phosphorus into the Upstream Snake River segment (RM 409 to 335), including municipal, stormwater and industrial discharges • Nonpoint sources including agriculture, stormwater, and natural loading • Tributary inflows to the SR-HC TMDL reach • Reduced assimilative capacity due to impoundments
Mercury (Hg)	• Point source discharges may be sources of mercury; no measured loading is available. Point sources include municipal, stormwater and industrial discharges • Major nonpoint sources include legacy mining and natural loading. Minor nonpoint sources include legacy seed treatments, landfills, domestic sludge, air deposition, cement plants and coal fired power plants • Tributary inflows to the SR-HC TMDL reach • Existing system loading
Nutrients Nuisance Algae	• Point sources discharging phosphorus into the Upstream Snake River segment (RM 409 to 335), including municipal, stormwater and industrial discharges • Nonpoint sources including agriculture, stormwater, and natural loading • Tributary inflows to the SR-HC TMDL reach
Pesticides	• Point source discharges are not considered to be significant sources of loading • Nonpoint sources include legacy pesticide application both within the SR-HC Subbasin and from upstream application • Tributary inflows to the SR-HC TMDL reach • Existing system loading
pH	No segments of the SR-HC TMDL reach were found to exceed the targets for pH.
Sediment (TSS)	• Point source discharges, including municipal, stormwater and industrial discharges, are not considered to be significant sources of loading with the exception of stormwater discharges • Nonpoint sources include erosion from agriculture, recreation and urban/suburban sources as well as natural loading • Tributary inflows to the SR-HC TMDL reach
Temperature	• Dominant source of loading is natural temperature influences • Point source discharges, including municipal, stormwater and industrial discharges, are sources of heating but are currently operating within the no measurable increase margin • Nonpoint sources include flow and temperature influences from agriculture, water management and urban/suburban sources • Tributary inflows to the SR-HC TMDL reach
Total Dissolved Gas (TDG)	• Spill from Brownlee and Hells Canyon Reservoirs

collected to support the SR-HC TMDL effort is sufficient to determine the level of support for designated beneficial uses within the system (i.e. bacteria, nutrients, pH, temperature, total dissolved gas). In some cases, enough data are available to make a preliminary assessment, but additional data are necessary before formal load allocations based on existing loading or designated use support status can be identified (i.e. mercury, pesticides and sediment). The following summary captures the basic findings of this assessment process. All topics are discussed in greater detail within the TMDL document and the attached appendices.

BACTERIA

The SR-HC TMDL reach is listed from RM 409 to 347 for bacteria. Analysis has shown that bacteria 303(d) listings are not indicated given the available data. Designated uses are not impaired due to elevated bacteria levels within any of the listed segments. Available data (1999

and 2000) were collected in an appropriate fashion for evaluation of the 30 day log mean, with a minimum of 5 samples over an appropriate time period collected at most sampling locations. Monitoring occurred during the summer season and correlates well not only with the period of time that conditions in the river would be conducive to bacterial growth, but also to the season of greatest primary contact recreation use. No exceedences were observed. Based on these findings, the SR-HC TMDL process recommends that the mainstem Snake River from RM 409 to 347 be delisted for bacteria by the State of Idaho. The SR-HC TMDL process further recommends that monitoring of bacteria levels (*E. coli*), especially in those areas of the SR-HC TMDL reach where recreational use consistently occurs, continue to be an integral part of the water quality monitoring of the Upstream Snake River and Brownlee Reservoir segments.

MERCURY

The SR-HC TMDL reach is listed from RM 409 to 188 for mercury. To date, data available show that mercury concentrations in the SR-HC reach of the Snake River exceed the fish tissue target established by this TMDL. Water column data are not available to allow an assessment of the use support status of aquatic life uses due to mercury concentrations within the SR-HC system.

All fish tissue data available in this reach were positive for mercury. A summary of these data show that the Oregon and Idaho levels of concern were exceeded by 80% (0.35 mg/kg) and 52% (0.5 mg/kg) respectively. Both states have acted to issue fish consumption advisories based on these exceedences. Primary sources of mercury within the SR-HC TMDL reach are legacy mining and natural loading. Both are associated with geological deposits of mercury within the Owyhee and Weiser watersheds. Based on these findings, and on the concerns associated with consumption of fish by both waterfowl and wildlife within the SR-HC TMDL reach, a TMDL is considered necessary.

Due to the fact that essentially no water column data are available to this effort, a TMDL cannot be established at this time for mercury in the SR-HC TMDL reach. Therefore, IDEQ and ODEQ have determined it is in the public interest to reschedule the mercury TMDL for the SR-HC TMDL reach. IDEQ has rescheduled completion of the mercury TMDL to 2006 in order to gather additional data to better determine the sources and extent of mercury contamination. This schedule change has been approved by US EPA. ODEQ's schedule for the mercury TMDL coincides with this date. The state of Oregon is developing capability to model site-specific bioaccumulation factors. Also, Oregon's mercury TMDL is not due until 2006. This schedule change will allow a better use of these capabilities and the opportunity to collect additional data. Both Idaho and Oregon have interim measures in place to deal with mercury contamination such as sediment controls and fish consumption advisories as described in Section 3.1. It is the opinion of the DEQs that this schedule change will not present an adverse impact to the SR-HC TMDL reach.

NUTRIENTS, NUISANCE ALGAE AND DISSOLVED OXYGEN

The SR-HC TMDL reach is listed from RM 409 to 272.5 for nutrients. Available data show excessive total phosphorus concentrations in the Upstream Snake River segment (RM 409 to 335) of the SR-HC reach. Nuisance algae blooms have been observed to occur routinely in the Upstream Snake River segment and the upstream sections of Brownlee Reservoir. It is evident

from data analysis that the distribution of chlorophyll *a* and total phosphorus concentrations observed in the Upstream Snake River segment (RM 409 to 335) of the SR-HC TMDL reach are elevated when compared to those observed in the Snake River system as a whole. This elevation cannot be wholly attributable to natural sources.

A comparison of conditions in the Upstream Snake River segment (RM 409 to 335) to conditions observed in the Snake River as a whole was used to identify site-specific chlorophyll *a* and total phosphorus targets (less than 14 ug/L and less than or equal to 0.07 mg/L respectively) for the SR-HC TMDL reach. These targets are seasonal in nature and apply from May through September. The 0.07 mg/L total phosphorus target represents a substantial reduction in the current average total phosphorus concentration in the SR-HC TMDL reach. A total phosphorus concentration of 0.07 mg/L correlates to an average chlorophyll *a* concentration of approximately 14 ug/L, which is within the range defined as appropriate for protection of designated aquatic life, domestic water supply and aesthetic/recreational beneficial uses. The reduction in total phosphorus observed in meeting the target concentration also represents a reduction of roughly 50 % in algal biomass (as measured by chlorophyll *a*). The calculated reduction in organic loading is projected to result in an improvement in dissolved oxygen levels in both the Upstream Snake River and Brownlee Reservoir segments.

The 14 ug/L chlorophyll *a* and 0.07 mg/L total phosphorus targets were developed to meet water quality criteria in the Upstream Snake River segment (RM 409 to 335). To identify the change in conditions in Brownlee Reservoir resulting from attainment of these targets in the Upstream Snake River segment, water quality in the reservoir was modeled using all inflowing waters at 0.07 mg/L of total phosphorus. The model output showed dissolved oxygen improvements in the epilimnion sufficient to meet the 6.5 mg/L criteria during the summer months. Dissolved oxygen levels concentrations in the metalimnion also showed improvement, although the projected improvements did not meet water quality targets. Modeling of long-term effects of attaining the targets project that substantial improvements in the hypolimnion will be realized over time.

Load allocations assigned to the inflowing tributaries are based on inflow concentrations meeting the 0.07 mg/L total phosphorus target. Direct point source dischargers to the Snake River operating mechanical treatment plants will be required to reduce discharge concentrations by 80%. Lagoon discharges will assess the feasibility of changing to land application or biological nutrient removal and implementation objectives will be assessed on a case by case basis. Nonpoint source discharges will be required to reduce to the 0.07 mg/L level. As modeling showed that the presence of Brownlee Reservoir acts to reduce the assimilative capacity of the river, additional dissolved oxygen required to offset this reduction in assimilative capacity will be the responsibility of Idaho Power Company and has been identified as a load allocation of 1,125 tons of dissolved oxygen per season.

PESTICIDES

The SR-HC TMDL reach is listed for pesticides from RM 285 to 272.5 (Oxbow Reservoir). Pesticides of concern to this TMDL are DDT and dieldrin, both of which are banned and no longer in use in the United States. Available pesticide data identified total DDT (t-DDT) and dieldrin concentrations in fish tissues throughout the Snake River and several major tributaries in Idaho.

The data show that concentrations of both t-DDT and cyclodiene compounds (dieldrin) increased with distance downstream. Reservoir concentrations (mean = 1,261 ug/kg fish tissue) were somewhat higher overall than tributary concentrations (mean = 990 ug/kg fish tissue), but the trend was evident in both types of surface waters. The reservoir samples exhibited greater variation than the riverine samples. Of the pesticides identified in the SR-HC TMDL reach, all samples showed t-DDT fish tissue concentrations that exceeded the EPA screening level; no samples showed dieldrin fish tissue concentrations that exceeded the EPA screening level. All water column samples (four data points for each compound) exhibited levels above the SR-HC TMDL targets for both DDT and dieldrin.

The available dieldrin data show that fish tissue concentrations were relatively similar throughout the Upstream Snake River segment (RM 409 to 335), increasing slightly within the Brownlee Reservoir samples. A comparison of mean values from the Upstream Snake River segment (riverine mean = 32.4 ug/kg fish tissue) with the Brownlee Reservoir segment (RM 335 to 285) (lacustrine mean = 45 ug/kg fish tissue) shows a relatively moderate difference. The Brownlee Reservoir samples showed much greater variation than the Upstream Snake River samples. In the small data set available for dieldrin, over 73% of the fish tissue data points (n = 16) showed concentrations of dieldrin that were above the detection limits.

Load allocations for new application of these pesticides are all zero as they are banned compounds. Due to the lack of data to accurately characterize pesticide loading to the Oxbow Reservoir segment (RM 285 to 272.5), and the diffuse and widespread legacy nature of pesticide loading to the Snake River, load allocations for legacy application and transport of DDT and dieldrin were assigned on a general basis for the Upstream Snake River segment (RM 409 to 335). These load allocations represent the sum of point and nonpoint source-related loading. Insufficient data are available to further differentiate pollutant sources within the segment. Pesticide targets apply year-round.

pH

The SR-HC TMDL reach is listed for pH from RM 409 to 347 and from RM 335 to 285. Analysis has shown that pH 303(d) listings are not supported by the available data. No exceedences were observed to occur in the data available for the Upstream Snake River segment (RM 409 to 335). Less than 1% exceedence was observed in the Brownlee Reservoir segment (RM 335 to 285). Data were collected over the course of several years and represent a variety of flow and water quality conditions. Based on these findings, the SR-HC TMDL process recommends that the mainstem Snake River from RM 409 to 347 and from RM 335 to 285 be delisted for pH by the State of Idaho. The SR-HC TMDL process further recommends that monitoring of pH continue to be an integral part of the water quality monitoring of the Upstream Snake River and Brownlee Reservoir segments.

Sediment

The SR-HC TMDL reach is listed for sediment from RM 409 to 272.5. No duration data are available to assess the extent of impairment or support in these reaches. Targets of no more than 50 mg/L total suspended solids (TSS) as a monthly average and less than or equal to 80 mg/L TSS for no more than 14 days have been set in a conservative fashion so that aquatic life uses

will be protected in the listed segments. These targets closely match those identified by IDEQ for the Lower Boise River (1998) and Mid-Snake River TMDLs (1997) so management of the Snake River system is consistent with previous approaches.

Sediment loading within the SR-HC TMDL reach is also of concern because of the attached pollutant loads (mercury, pesticides and nutrients) that the sediment carries. In the SR-HC TMDL, sediment targets and monitored trends will function as an indicator of changes in transport and delivery for these attached pollutants. The available data show that over 95% of the sediment loading into the SR-HC TMDL reach originates in the Upstream Snake River segment (RM 409 to 335). Sources of unmeasured load may include nonpoint source runoff from anthropogenic sources, precipitation events, unidentified small tributaries and drains. Sediment targets apply year round.

TEMPERATURE

The SR-HC TMDL reach is listed from RM 409 to 188 for temperature. Elevated summer water temperatures have been measured in both the Upstream Snake River segment near Weiser, Idaho (RM 351), in the Hells Canyon Complex reservoirs, and in the Downstream Snake River segment prior to the construction of the dams. Summertime water temperatures routinely exceed 24 ^{o}C in both the current and the historic data. Temperature loading calculations within the SR-HC TMDL reach have shown that natural sources and non-quantifiable sources were the dominant cause of temperature exceedences. (Non-quantifiable influences include the effects of upstream and tributary impoundments, water withdrawals, channel straightening and diking and removal of streamside vegetation.) Calculated natural and non-quantifiable background temperature influences to the mainstem Snake River within the SR-HC TMDL reach equal over 90% of the increase in water temperature for the critical months of June, July, August and September. It is well recognized that in hot, arid climates such as that in which the SR-HC TMDL reach is located, natural atmospheric heat sources will have a noticeable influence on water temperatures.

To address salmonid rearing temperature concerns the following point and nonpoint source load allocations have been identified. Point sources discharging directly to the Snake River within the SR-HC TMDL reach have been allocated heat loads corresponding to discharge loads applied to design flows to ensure that no measurable increase requirements will not be exceeded. A waste load allocation for future point sources of no measurable increase has been identified as part of this TMDL.

A gross nonpoint source temperature load allocation has been established at no greater than 0.14 ^{o}C for nonpoint sources in the SR-HC TMDL reach. (This applies primarily to agricultural and stormwater drains and similar inflows.) This allocation applies at discharge to the Snake River in the SR-HC TMDL reach, during those periods of time that the site-potential temperature in the mainstem Snake River is greater than 17.8 ^{o}C. It is projected that implementation associated with total phosphorus and total suspended solids reductions will result in reduced inflow temperatures in the smaller drains and tributaries to the mainstem Snake River as many of the approved methods for the reduction of total phosphorus and suspended solids are based on streambank revegetation and similar methodologies that will increase shading.

A gross nonpoint source temperature load allocation has been established at no greater than 0.14 ^{o}C for tributaries in the SR-HC TMDL reach. This is equal to the sum of the waste load allocation and the load allocation for anthropogenic tributary sources. This allocation applies at the inflow to the Snake River in the SR-HC TMDL reach, during those periods of time that the site-potential temperature in the mainstem Snake River is greater than 17.8 ^{o}C. Anthropogenic temperature influence assessments, similar to those conducted for the Lower Boise River and the SR-HC TMDL reach will be completed as part of the tributary TMDL processes. If anthropogenic sources within the drainage are observed to exceed the no measurable increase value for the tributary inflow, load allocations will be identified through the tributary TMDL process.

A temporal shift in water temperatures exiting Hells Canyon Dam is observed during the late fall and winter months; the decline in temperatures in the fall is delayed from that observed immediately upstream of the Hells Canyon Complex. While the temporal distribution of this temperature shift is due to the delay in flow caused by water moving through the Hells Canyon Complex, the actual heat load (warmer water) is not. The impoundments are not a heat source. Sources of elevated water temperature include natural, non-quantifiable and anthropogenic sources upstream of the Hells Canyon Complex and similar sources on inflowing tributaries. Because peak summer temperatures are several degrees cooler due to withdrawals from below the reservoir surface, and modeling has demonstrated that releases from Hells Canyon Dam would meet cold water aquatic life/salmonid rearing water temperature targets if waters inflowing to the reservoirs met cold water aquatic life/salmonid rearing targets, it is concluded that the Hells Canyon Complex reservoirs are not contributing to temperature exceedences specific to the cold water aquatic life/salmonid rearing designated use

However, water temperature modeling also shows that even if the inflowing water temperature met water quality targets for salmonid spawning at the onset of salmonid spawning (October 23 for fall chinook), the water exiting the Hells Canyon Complex would not meet the salmonid spawning criteria (although by only a small margin) because of the temporal shift created by the Hells Canyon Complex. It is, therefore, concluded that the responsibility for exceeding the salmonid spawning criteria is specific to the presence and operation of the Hells Canyon Complex.

To address violations of the water quality criteria for salmonid spawning temperatures, a thermal site-potential for water downstream of Hells Canyon Dam was established as the water temperature at RM 345 (approximately 10 miles upstream of Farewell Bend) using data from 1991 to 2001. A temperature load allocation in the form of a required temperature change at Hells Canyon Dam was identified as a change in water temperature such that the temperature of water released from Hells Canyon Dam is less than or equal to the water temperature at RM 345, or the maximum weekly maximum temperature target of 13 °C for salmonid spawning, plus the allowable temperature change defined as no greater than 0.14 ^{o}C. The entire load for the Downstream Snake River segment (RM 247 to 188) is allocated to the Hells Canyon Complex of dams owned and operated by IPCo. Specific compliance parameters for meeting this load allocation will be defined as part of the 401 Certification process.

TOTAL DISSOLVED GAS

Elevated total dissolved gas levels are the result of releasing water over spillways of dams. Gas supersaturation is caused when air becomes dissolved in water while spilling over a dam into the depth of a plunge pool. High hydrostatic pressure causes the air to be driven into solution, resulting in supersaturation. Spill at Brownlee and Hells Canyon Dams is the source of elevated total dissolved gas in the SR-HC reach. At this time, voluntary spill does not occur within the Hells Canyon Complex. Spill at dams occurs only involuntarily, usually as a result of flood control constraints. The magnitude of the exceedence (to some extent) and the total distance downstream of the dam where water was observed to exceed the less than 110% standard are observed to be directly related to the volume of the spill. Observed ranges of total dissolved gas loading to the Oxbow Reservoir, Hells Canyon Reservoir and Downstream Snake River segments are between 114% to 128% for spill from Brownlee Dam and 108% to 136% for spill from Hells Canyon Dam.

As spill over Brownlee and Hells Canyon Dams is the source of elevated total dissolved gas in the SR-HC TMDL reach, the entire load allocation is assigned to the Hells Canyon Complex. This load allocation applies to each location where spill occurs (i.e. a load allocation of less than 110% maximum saturation applies to the tailwaters of Oxbow Reservoir during spill from Brownlee Dam, and a load allocation of less than 110% maximum saturation applies to the Downstream Snake River segment during spill from Hells Canyon Dam).

Water Quality Targets

Because the Snake River from RM 409 to 188 is an interstate water body with the state boundary line described as the centerline of the river, water quality standards and particularly water quality criteria for both Oregon and Idaho must be attained. Because the state line between Oregon and Idaho is in the middle of the mainstem Snake River, the waters of both states are mixed mid-river. Therefore waters from both sides must meet the criteria of both states in the mainstem. This is accomplished by determining which standards are the most stringent and applying those criteria as targets for this TMDL.

Due to the use of different methodology for each state, it is not immediately obvious which standards represent the most stringent values. A direct calculation of stringency was therefore undertaken for standards for which numeric criteria had been established. In the case of those pollutants where numeric criteria were not available, reasonable state and federal guidelines and guidance documents have been applied in correlation with the current understanding of the system and the physical constraints imposed by naturally occurring conditions. The resulting water quality targets for the SR-HC TMDL are listed in Table D.

TMDL Summaries

TMDLs have been written for nutrients/dissolved oxygen, pesticides, sediment, temperature and total dissolved gas. The following pages represent a summary of the information specific to each of the TMDLs written for the SR-HC TMDL reach.

Table D. Water quality targets specific to the Snake River - Hells Canyon TMDL.

Parameter	Selected Target	Where Applied
Bacteria	Less than 126 *E coli* organisms per 100 mL as a 30 day log mean with a minimum of 5 samples AND no sample greater than 406 *E coli* organisms per 100 mL	Full SR-HC TMDL reach (RM 409 to 188), year-round
Dissolved Oxygen (DO) • Cold water aquatic life and salmonid rearing	8 mg/L water column dissolved oxygen as an absolute minimum, OR (where conditions of barometric pressure, altitude, and temperature preclude attainment of 8 mg/L) dissolved oxygen levels shall not be less than 90%; unless adequate, i.e. continuous monitoring, data are collected to allow assessment of the multiple criteria section in the standards.	Downstream Snake River Segment (RM 247 to 188), year-round
• Salmonid spawning, when and where it occurs	11 mg/L water column dissolved oxygen as an absolute minimum OR (where conditions of barometric pressure, altitude, and temperature preclude attainment of 11 mg/L) dissolved oxygen levels shall not be less than 95%; with intergravel dissolved oxygen not lower than 8 mg/L, unless adequate, i.e. continuous monitoring, data are collected to allow assessment of the multiple criteria section in the standards. These targets will apply only to that portion of the SR-HC TMDL reach below Hells Canyon Dam (RM 247 to 188), from October 23rd to April 15th for fall chinook, and from November 1st to March 30th for mountain whitefish.	Downstream Snake River Segment (RM 247 to 188), October 23 to April 15
• Cool water aquatic life	6.5 mg/L water column as an absolute minimum, unless adequate, i.e. continuous monitoring, data are collected to allow assessment of the multiple criteria section in the standards.	Full SR-HC TMDL reach (RM 409 to 188), year-round
Mercury (Hg)	Less than 0.012 ug/L water column concentration (total) Less than 0.35 mg/kg in fish tissue	Full SR-HC TMDL reach (RM 409 to 188), year-round
Nuisance Algae	14 ug/L mean growing season limit (nuisance threshold of 30 ug/L with exceedence threshold of no greater than 25%)	Full SR-HC TMDL reach (RM 409 to 188), May through September
Nutrients	Less than or equal to 0.07 mg/L total phosphorus	Full SR-HC TMDL reach (RM 409 to 188), May through September
Pesticides	Less than 0.024 ng/L water column concentration DDT Less than 0.83 ng/L water column concentration DDD Less than 0.59 ng/L water column concentration DDE Less than 0.07 ng/L water column concentration Dieldrin	Oxbow Reservoir Segment (RM 285 to 272.5) and upstream waters, year-round
pH	7 to 9 pH units	Full SR-HC TMDL reach (RM 409 to 188), year-round
Sediment (Turbidity)	Less than or equal to 80 mg TSS/L for acute events lasting no more than 14 days, and less than or equal to 50 mg TSS/L monthly average	Full SR-HC TMDL reach (RM 409 to 188), year-round
Temperature • Cold water aquatic life and salmonid rearing	17.8 ^{o}C (expressed in terms of a 7-day average of the maximum temperature) if and when the site potential is less than 17.8 ^{o}C. If and when the site potential is greater than 17.8 ^{o}C, the target is no more than a 0.14 ^{o}C increase from anthropogenic sources. When aquatic species listed under the Endangered Species Act are present and if a temperature increase would impair the biological integrity of the Threatened and Endangered population	Full SR-HC TMDL reach (RM 409 to 188), year-round

Parameter	Selected Target	Where Applied
	then the target is no greater than 0.14 ^{o}C increase from anthropogenic sources.	
• Salmonid spawning, when and where it occurs for specific species	A maximum weekly maximum temperature of 13 ^{o}C (when and where salmonid spawning occurs) if and when the site potential is less than a maximum weekly maximum temperature of 13 ^{o}C. If and when the site potential is greater than a maximum weekly maximum temperature of 13 ^{o}C, the target is no more than a 0.14 ^{o}C increase from anthropogenic sources. When aquatic species listed under the Endangered Species Act are present and if a temperature increase would impair the biological integrity of the Threatened and Endangered population then the target is no greater than 0.14 ^{o}C increase from anthropogenic sources. These targets will apply only to that portion of the SR-HC TMDL reach below Hells Canyon Dam (RM 247 to 188), from October 23rd to April 15th for fall chinook, and from November 1st to March 30th for mountain whitefish.	Downstream Snake River Segment (RM 247 to 188), October 23 to April 15
Total Dissolved Gases	Less than 110%	Oxbow Reservoir to the Salmon River Inflow (RM 285 to 188), year-round

TMDL summaries are not included for the bacteria and the pH listings for the Upstream Snake River and Brownlee Reservoir segments as data show that targets are being met and both are recommended for delisting by the State of Idaho. No final TMDL could be prepared for mercury due to a lack of water column data. This TMDL has been postponed to 2006. Data will be collected during the intervening time period and a full assessment completed by 2006. TMDL summaries for all other listed pollutants follow.

NUTRIENTS, NUISANCE ALGAE, DISSOLVED OXYGEN (DO)

Pollutant of Concern:	***Nutrients, Nuisance Algae, Dissolved Oxygen***
Segments Listed: (See Tables A-1 and B-1 for specific stream segments)	Idaho: Upstream Snake River, Brownlee Reservoir, Oxbow Reservoir Oregon: None
Uses Affected:	Aesthetics, Recreation, Resident Fish and Aquatic Life At Risk: Domestic Water Supply
Known Sources:	Point source discharges including municipal, stormwater and industrial discharges Nonpoint sources including agriculture, stormwater and natural loading Tributary inflows to the SR-HC TMDL reach Reduced assimilative capacity due to impoundments
Indications of Impairment:	Excessive algae growth occurring in the Upstream Snake River segment (RM 409 to 335), excessive algae growth in the upstream sections of Brownlee Reservoir and associated dissolved oxygen problems.
Target(s): (see Table 2.2.2 for further detail)	A minimum of 6.5 mg/L dissolved oxygen for listed segments upstream of Hells Canyon Dam, minimum of 8 mg/L dissolved oxygen downstream. No greater than 14 ug/L mean growing season chlorophyll *a* limit (nuisance threshold of 30 ug/L). A maximum of 0.07 mg/L total phosphorus instream.
Critical Conditions:	Dissolved oxygen requires year round application of the target Chlorophyll *a* and total phosphorus target attainment critical May through September.
Capacity: (total phosphorus, May through September)	Upstream Snake River: 2,735 kg/day Brownlee Reservoir: 2,829 kg/day Oxbow Reservoir: 2,839 kg/day
Loading: (total phosphorus, May through September)	Point Sources: 516 kg/day at design flow Nonpoint Sources: Upstream Snake River: 5,899 kg/day Brownlee Reservoir: 3,288 kg/day (calculated at Brownlee Dam) Oxbow Reservoir: 2,918 kg/day (calculated at Oxbow Dam)
TMDL:	Written for all listed segments based on the 14 ug/L mean growing season chlorophyll *a* and 0.07 mg/L total phosphorus targets.
Waste Load Allocations: (total phosphorus, May through September)	All mechanical plants discharging directly to the Snake River within the SR-HC TMDL reach will attain 80% reduction in total phosphorus loading. Lagoon system waste load allocations are set at existing design-flow loading.
Load Allocations*: (*values were determined for an average water year and include natural loading. Target is no greater than 0.07 mg/L total phosphorus instream.) (total phosphorus, May through September)	Snake River inflow: 1,379 kg/day Owyhee River inflow: 71 kg/day Boise River inflow: 242 kg/day Malheur River inflow: 58 kg/day Payette River inflow: 469 kg/day Weiser River inflow: 136 kg/day Drains: 91 kg/day Ungaged: 137 kg/day (including stormwater and overland agricultural runoff) Total Upstream Snake River (nonpoint sources): 2,735 kg/day Brownlee Reservoir: 2,829 kg/day Burnt River: 21 kg/day Powder River: 33 kg/day Oxbow Reservoir: 2,839 kg/day

Pollutant of Concern:	***Nutrients, Nuisance Algae, Dissolved Oxygen***
	Dissolved oxygen load allocation of 1,125 tons seasonally, specific to the transition zone and metalimnion of Brownlee Reservoir to offset reduction in assimilative capacity.
Margin of Safety:	Explicit 13% based on sampling and analytical error, and conservative assumptions
Implementation Time Frame:	Point source implementation within time frames identified by NPDES permit schedules. Nonpoint source implementation to begin with completion of site-specific implementation plans (18 months after approval of TMDL) and to proceed with all deliberate speed. Draft interim goals at 0.01 mg/L total phosphorus decrease in mainstem waters every 10 years Schedule specifics will be determined as part of the implementation planning process. The potential for long-term time frames (up to 70 years) for full system potential to be realized. Implementation of the dissolved oxygen load allocation to Brownlee Reservoir will be timed similar to the nonpoint source implementation schedule. If direct oxygenation is selected as the implementation mechanism, addition will be timed for those periods of low dissolved oxygen and correlated with reservoir monitoring to allow the most effective use of injected dissolved oxygen to the reservoir.
Monitoring Needs:	Point source monitoring of discharge concentrations to track progress, nonpoint/agency monitoring of mainstem concentrations to track progress.

More detail on the general points in the TMDL summary can be found in the loading analysis discussion in Section 3.0 and in the discussion of load allocations in Section 4.0.

PESTICIDES

Pollutant of Concern:	***Pesticides (DDT and Dieldrin, and degradation products)***
Segments Listed: (See Tables A-1 and B-1 for specific stream segments)	Idaho: Oxbow Reservoir Oregon: None
Uses Affected:	Fishing Additional data necessary to evaluate support status of cold water aquatic life/salmonid rearing, resident fish and aquatic life, wildlife and hunting
Known Sources:	Point source discharges are not considered to be significant sources of loading. Nonpoint sources include legacy pesticide application both within the SR-HC Subbasin and drainage area upstream, tributary inflows to the SR-HC TMDL reach and existing system loading from legacy application.
Indications of Impairment:	Fish tissue exceedences of DDT action levels (US EPA) and water column exceedences of SR-HC TMDL DDT and dieldrin targets.
Target(s): (see Table 2.2.2 for further detail)	Less than 0.024 ng/L water column concentration DDT Less than 0.83 ng/L water column concentration DDD Less than 0.59 ng/L water column concentration DDE Less than 0.07 ng/L water column concentration Dieldrin
Critical Conditions:	Year round
Capacity:	Upstream Snake River: 0.34 kg/year (t-DDT), 0.98 kg/year (dieldrin) Brownlee Reservoir: 0.37 kg/year (t-DDT), 1.1 kg/year (dieldrin) Oxbow Reservoir: 0.37 kg/year (t-DDT), 1.1 kg/year (dieldrin)
Loading:	Upstream Snake River: 42 grams/year (t-DDT), 28 kg/year (dieldrin) (Based on an extremely small data set)
TMDL:	Written for upstream and listed segment based on the water-column targets identified for DDT and dieldrin
Load Allocations:	Zero load allocation for new application. Bulk load allocation to point and nonpoint sources set at load capacity less 10% margin of safety.
Margin of Safety:	Explicit, 10%
Implementation Time Frame:	Concurrent with nonpoint source implementation as identified by sediment and nutrient TMDLs.
Monitoring Needs:	Nonpoint/agency monitoring of mainstem concentrations to determine loading, continued fish tissue monitoring to determine trends and progress monitoring.

More detail on the general points in the TMDL summary can be found in the loading analysis discussion in Section 3.0 and in the discussion of load allocations in Section 4.0.

SEDIMENT

Pollutant of Concern:	***Sediment***
Segments Listed: (See Tables A-1 and B-1 for specific stream segments)	Idaho: Upstream Snake River, Brownlee Reservoir, Oxbow Reservoir Oregon: None
Uses Affected:	Aesthetics, Recreation, Resident Fish and Aquatic Life, Fishing Duration data necessary to determine aquatic life use support status
Known Sources:	Point source discharges including municipal and industrial discharges. Nonpoint sources including agriculture, stormwater and natural loading, and tributary inflows to the SR-HC TMDL reach.
Indications of Impairment:	Lack or degradation of habitat, population decline. (See mercury, nutrient, and pesticide discussions for attached pollutant concerns.)
Target(s): (see Table 2.2.2 for further detail)	Less than or equal to 80 mg/L total suspended solids (TSS) for acute events lasting less than 14 days, and less than or equal to 50 mg TSS/L monthly average.
Critical Conditions:	Year round
Capacity: (TSS)	Upstream Snake River: 1,265,630 kg/day Brownlee Reservoir: 1,290,200 kg/day Oxbow Reservoir: 1,305,682 kg/day
Loading:	Point Sources: Design flow = 722 kg/day Nonpoint Sources: Upstream Snake River: 1,483,691 kg/day Brownlee Reservoir: loading cannot be calculated due to reservoir sink effect Oxbow Reservoir: loading cannot be calculated due to reservoir sink effect
TMDL:	Written for all listed segments based on the SR-HC TMDL TSS targets as protective for aquatic life and as indicators of changes in transport and delivery of attached pollutants.
Waste Load Allocations:	NPDES permits set at current limits for point source discharges.
Load Allocations and Threshold Values*: (* Threshold values are based on anti-degradation requirements established at currently measured loads)	Snake River inflow: 677,785 kg/day (threshold value) Owyhee River inflow: 48,007 kg/day Boise River inflow: 130,466 (threshold value) Malheur River inflow: 42,062 kg/day Payette River inflow: 137,887 kg/day (threshold value) Weiser River inflow: 53,617 kg/day (threshold value) Drains: 57,628 kg/day Ungaged: 118,178 kg/day, (including stormwater and overland agricultural runoff) Total Upstream Snake River (nonpoint sources): 1,265,630 kg/day Burnt River: 9,713 kg/day Powder River: 14,857 kg/day (threshold value)
Margin of Safety:	Explicit, 10%
Implementation Time Frame:	Nonpoint source implementation to begin concurrent with nutrient reduction measures. No additional implementation measures are expected based on sediment alone. If fully implemented, nutrient reduction measures should act to reduce sediment sufficient to meet load allocations. Schedule specifics will be determined as part of the implementation planning process. The potential for long-term time frames (up to 70 years) for full system potential to be realized.

Pollutant of Concern:	***Sediment***
Monitoring Needs:	Nonpoint/agency monitoring of duration-based concentrations in mainstem, and progress monitoring.

More detail on the general points in the TMDL summary can be found in the loading analysis discussion in Section 3.0 and in the discussion of load allocations in Section 4.0.

TEMPERATURE

Pollutant of Concern:	***Temperature***
Segments Listed: (See Tables A-1 and B-1 for specific stream segments)	Idaho: Downstream Snake River Oregon: Upstream Snake River, Brownlee Reservoir, Oxbow Reservoir, Hells Canyon Reservoir, Downstream Snake River
Uses Affected:	Cold Water Aquatic Life/Salmonid Rearing, Salmonid Spawning* (*below Hells Canyon Dam)
Known Sources:	Dominant source of loading is natural and non-quantifiable temperature influences. Non-quantifiable influences including the effects of upstream and tributary impoundments, water withdrawals, channel straightening and diking and removal of streamside vegetation. Point source discharges, including municipal, stormwater and industrial discharges, are sources of heating but are currently operating within the no measurable increase margin. Nonpoint sources include flow and temperature influences from agriculture, water management, geothermal (natural and urban/suburban sources, and tributary inflows to the SR-HC TMDL reach.
Indications of Impairment:	Exceedences of the temperature target for cool and cold water aquatic life and salmonid rearing occurring during June, July, August and September throughout the SR-HC TMDL reach. Exceedences were observed historically in the Upstream Snake River segment (RM 409 to 335) and in the reservoir segments before the impoundments were in place. Exceedences of the temperature target for salmonid spawning occurring during mid-October for fall chinook in the Downstream Snake River segment.
Target(s): (see Table 2.2.2 for further detail)	Cold water Aquatic Life/Salmonid Rearing: Less than 0.14 ^{o}C increase from anthropogenic sources when the site potential is greater than 17.8 ^{o}C Salmonid Spawning: A maximum weekly maximum temperature of 13 ^{o}C (when and where salmonid spawning occurs) if and when the site potential is less than a maximum weekly maximum temperature of 13 ^{o}C. If and when the site potential is greater than a maximum weekly maximum temperature of 13 ^{o}C, the target is no more than a 0.14 ^{o}C increase from anthropogenic sources. Applicable to RM 247 to 188 only, from October 23rd to April 15th for fall chinook, and from November 1st to March 30th for mountain whitefish. Less than a 0.14 ^{o}C increase from anthropogenic sources when aquatic species listed under the Endangered Species Act are present and a temperature increase would impair the biological integrity of the Threatened and Endangered population. *Please see Table D for greater detail.*
Critical Conditions:	June through September for cold water aquatic life/salmonid rearing October 23rd through April 15th for salmonid spawning (below Hells Canyon Dam).
Capacity:	No measurable increase (defined as 0.14 ^{o}C for this TMDL) Upstream Snake River: less than 0.14 ^{o}C cumulative loading Brownlee Reservoir: less than 0.14 ^{o}C cumulative loading Oxbow Reservoir: less than 0.14 ^{o}C cumulative loading Hells Canyon Reservoir: less than 0.14 ^{o}C cumulative loading

Pollutant of Concern:	***Temperature***
	Downstream Snake River: less than 0.14 ^{o}C cumulative loading
Anthropogenic Loading:	Cold water aquatic life/salmonid rearing: Upstream Snake River: less than 0.05 ^{o}C cumulative loading Brownlee Reservoir: less than 0.013 ^{o}C cumulative loading Oxbow Reservoir: less than 0.013 ^{o}C cumulative loading Hells Canyon Reservoir: less than 0.008 ^{o}C cumulative loading Downstream Snake River: less than 0.005 ^{o}C cumulative loading Salmonid Spawning: Temporal shift at the outlet of Hells Canyon Dam. Water leaving the dam is warmer in the fall than upstream water temperatures and cooler in the spring than upstream water temperatures. Some of this temporal shift occurs during the spawning period for fall chinook (starting October 23). Exceedences of the salmonid spawning temperature occur from October 23 thorough 06 November immediately below the Hells Canyon Dam.
TMDL:	Written for all listed segments
Waste Load Allocations:	Cold water aquatic life/salmonid rearing: Current discharge loads applied to design flows to ensure that no measurable increase will not be exceeded Salmonid Spawning: not applicable
Load Allocations:	Cold water aquatic life/salmonid rearing: Anthropogenic nonpoint source loading less than 0.14 ^{o}C, Temperature assessments on a tributary drainage basis. Salmonid Spawning: Idaho Power Company ΔT resulting in water temperatures at the discharge of Hells Canyon Dam of no more than 0.14 ^{o}C above those observed at RM 345 or water temperatures less than 13 ^{o}C (daily maximum) at the discharge of Hells Canyon Dam, October 23rd through 15 April.
Margin of Safety:	Point Sources: Explicit MOS of 10% Nonpoint Sources: Implicit, as defined by criteria application in target.
Implementation Time Frame:	Point source implementation within time frames identified by NPDES permit schedules. Nonpoint source actions for nutrient/sediment reduction should include those practices that can result in localized temperature improvements such as revegetation of streambanks and efficient water usage. Implementation will follow nutrient/sediment implementation schedule. Tributary assessments of anthropogenic temperature influences as defined by tributary TMDL schedules.
Monitoring Needs:	Point source monitoring of discharge temperatures as part of routine reports, tributary monitoring to assess anthropogenic temperature influences, and progress monitoring.

More detail on the general points in the TMDL summary can be found in the loading analysis discussion in Section 3.0 and in the discussion of load allocations in Section 4.0.

TOTAL DISSOLVED GAS (TDG)

Pollutant of Concern:	***Total Dissolved Gas***
Segments Listed: (See Tables A-1 and B-1 for specific stream segments)	Idaho: None Oregon: None Addressed through request from Public Advisory Team members
Uses Affected:	Resident Fish and Aquatic Life, Cold Water Aquatic Life/Salmonid Rearing
Known Sources:	Spill from Brownlee and Hells Canyon Reservoirs
Indications of Impairment:	Greater than 110% of total dissolved gas saturation Gas bubble disease in fish Exceedences of the total dissolved gas target are observed to occur in Oxbow, Hells Canyon reservoirs and in the Downstream Snake River segment during periods of spill.
Target(s):	Less than 110% of saturation (see Table 2.2.2 for further detail)
Critical Conditions:	Year round
Capacity:	Less than 110% of saturation
Loading:	Oxbow and Hells Canyon Reservoir segments: 114% to 128% saturation during spill from Brownlee Dam. Downstream Snake River segment: 108% to 136% saturation during spill from Hells Canyon Dam.
TMDL:	Written for the Oxbow Reservoir, Hells Canyon Reservoir and Downstream Snake River segments.
Waste Load Allocations:	No point source loading for total dissolved gas.
Load Allocations:	Less than 110% of saturation at the edge of the aerated zone below Brownlee Dam, Oxbow Dam and Hells Canyon Dam.
Margin of Safety:	Implicit, using conservative criteria established for protection of designated aquatic life uses.
Implementation Time Frame:	Appropriate to engineering and design/operation studies to identify mechanisms to reduce saturation. Commensurate with correlated FERC and 401 Certification process requirements.
Monitoring Needs:	Monitoring of discharge total dissolved gas concentrations as part of routine progress monitoring.

More detail on the general points in the TMDL summary can be found in the loading analysis discussion in Section 3.0 and in the discussion of load allocations in Section 4.0.

Reasonable Assurance

All identified point sources discharging to the Snake River within the SR-HC TMDL reach are permitted facilities administered by the US EPA (Idaho facilities) or the State of Oregon (Oregon facilities). Wasteload (WLAs) reductions can be precipitated by modification of the NPDES permit. However, the load reductions needed to achieve desired water quality and restore full support of designated beneficial uses in the SR-HC TMDL reach will not be achieved in entirety by upgrades of the point sources.

For watersheds that have a combination of point and nonpoint sources where pollution reduction goals can only be achieved by including some nonpoint source reduction, a reasonable assurance that reductions will be met must be incorporated into the TMDL. The load reductions for the SR-HC TMDL will rely on nonpoint source reductions to meet the load allocations to achieve desired water quality and to restore designated beneficial uses. To ensure that nonpoint source reduction mechanisms are operating effectively, and to give some quantitative indication of the reduction efficiency for in-place BMPs, monitoring will be conducted. The monitoring will not be carried out on a site-specific basis but rather as a suite of indicator analyses monitored at the inflow and outflow of the segments within the SR-HC TMDL reach and at other appropriate locations such as the inflow of tributaries.

The states have responsibility under Section 401 of the CWA to provide water-quality certification. Under this authority, the states review projects to determine applicability to local water-quality issues. The State of Idaho and State of Oregon water-quality standards refer to other programs whose mission is to control nonpoint pollution sources. Some of these programs and responsible agencies are listed in Table E.

Table E. State regulatory authority for nonpoint pollution sources.

Citation	Idaho responsible agency	Oregon responsible agency
Rules governing forest practices	Idaho Department of Lands	Oregon Department of Forestry
Rules governing solid waste management	Idaho Department of Environmental Quality / Health Districts	Oregon Department of Environmental Quality
Rules governing subsurface and individual sewage disposal systems	Idaho Department of Environmental Quality / Health Districts	Oregon Department of Environmental Quality
Rules and standards for stream channel alteration	Idaho Department of Water Resources	Oregon Division of State Lands
Rules governing exploration and surface mining operations	Idaho Department of Lands	Oregon Department of Geology and Mineral Industries
Rules governing placer and dredge mining	Idaho Department of Lands	Oregon Division of State Lands
Rules governing dairy waste	Idaho Department of Agriculture	Oregon Department of Agriculture

If instream monitoring indicates an increasing pollutant concentration trend (not directly attributable to environmental conditions) or a violation of standards despite use of approved

BMPs or knowledgeable and reasonable efforts, then BMPs for the nonpoint sources activity must be modified by the appropriate agency to ensure protection of beneficial uses (Subsection 350.02.b.ii). This process is known as the "feedback loop" in which BMPs or other efforts are periodically monitored and modified if necessary to ensure protection of beneficial uses. With continued instream monitoring, the TMDL will initiate the feedback loop process and will evaluate the success of BMP implementation and its effectiveness in controlling nonpoint source pollution.

If a nonpoint pollutant(s) is determined to be impacting beneficial uses and the activity already has in-place referenced BMPs, or knowledgeable and reasonable practices, the state may request the BMPs be evaluated and/or modified to determine appropriate actions. If evaluations and/or modifications do not occur, injunctive relief may be requested (IDAPA 16.01.02350.2, ii (1); OAR 46EB.025 and 46EB.050).

It is expected that a voluntary approach will be able to achieve load allocations needed. Public involvement along with the commitment of the agricultural community have demonstrated a willingness to implement BMPs and protect water quality. In the past, cost-share programs have provided the agricultural community technical assistance, information and education, and the cost share incentives to implement BMPs. The continued funding of these projects will be critical for the load allocations to be achieved in the SR-HC TMDL.

Water Quality Management Plan and General Implementation Plan

To fulfil the requirements of the State of Oregon TMDL process, a Water Quality Management Plan or Implementation Plan must be submitted to the US EPA with the SR-HC TMDL. IDEQ guidance states that a TMDL implementation plan should be developed within eighteen months of the approval of the TMDL it is intended to support and supplement. Because of this difference in procedure, a general plan will be submitted with the SR-HC TMDL.

A general document is being submitted to fulfill the requirements of the TMDL process. However, substantial differences in state procedure and policy for implementation of TMDLs exist between Oregon and Idaho. Therefore, this document contains two separate, state-specific plans: the State of Oregon General Water Quality Management plan, and the State of Idaho General Implementation Plan. Together, these documents represent the general water quality management plan (implementation plan) for the SR-HC TMDL. More detailed, site-specific implementation plans will be prepared within 18 months of the approval of the SR-HC TMDL.

Conclusions

There is a substantial amount of data available to this effort. While some parameters will require additional monitoring in order to complete the TMDL process, this robust database has made an initial assessment of system needs and designated use requirements possible. The following, general conclusions are the result of the assessment and TMDL process:

- Bacteria and pH listings were not found to be supported by the data and have been recommended for delisting.

- Mercury concentrations were observed to be in excess of the SR-HC TMDL fish tissue targets in over 85% of the data and fish tissue consumption advisories remain in place, but no final TMDL could be prepared due to a lack of water column data. This TMDL has been postponed to 2006. Data will be collected during the intervening time period and a full assessment completed by 2006.

- The assessment of water quality conditions within the SR-HC TMDL reach identified designated beneficial use impairment from excessive nutrient loading in the Upstream Snake River (RM 409 to 335) and Brownlee Reservoir (RM 335 to 285) segments.

- While little data were available for pesticides within the SR-HC TMDL reach, and no data were available for the listed segment (Oxbow Reservoir), the data available indicate that pesticide transport within the SR-HC TMDL reach should be minimized. Implementation of concurrent pollutant reductions for total phosphorus is projected to result in reductions in pesticide transport and delivery within the SR-HC TMDL reach.

- Similarly, the influence of sediment, listed as a pollutant in the Upstream Snake River, Brownlee and Oxbow Reservoir segments, on aquatic life uses could not be fully assessed due to lack of duration data. However, excessive concentrations of sediment were identified based on monthly averages from some tributary and drain inflows. Additionally, sediment was identified as a transport mechanism for mercury, pesticides and nutrients within the SR-HC TMDL reach.

- Atmospheric and non-quantifiable influences were identified as the primary source of temperature exceedences and an in-depth evaluation of cold water refugia in the reservoirs demonstrated the critical nature of such habitat to the arid SR-HC TMDL reach.

- Total dissolved gas was identified as a pollutant of concern by SR-HC PAT members and an assessment of exceedences and impairment was completed. Exceedences of the total dissolved gas target were observed to be the result of spill over Brownlee and Hells Canyon Dams. Load allocations to meet the water quality targets were assigned to the Brownlee and Hells Canyon Dams.

As demonstrated by the size and diversity of the issues addressed in this document, the SR-HC TMDL reach is a highly complex system and will no doubt yield unexpected results as implementation and further data collection proceeds. The challenges encountered in determining designated beneficial use support and system impairment are an outgrowth of this complexity and will require additional assessment and revisitation as our understanding of the system evolves. Additionally, due to the complexity encountered and the enormous geographic scope of this effort, an extended time period for implementation and system response will be required. Generally, TMDL processes are expected to be completed within ten to 15 years of approval, this system, with its sequential tributary TMDL processes, wide diversity of land use and staggering size will not doubt require several decades to respond completely to implementation projects and changes in management.

Because of the complex nature and the extended time frame required, it is absolutely critical that the SR-HC TMDL remain a truly iterative process whereby our improved understanding of the system can be re-applied to the initial targets and goals as time passes, and that these targets and goals can be updated to better reflect system needs and appropriate management.